

Mars and Hippocrates in Megapolis: Urban Combat and Medical Support

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Introduction

“Don’t go there” is the conventional wisdom for military forces and cities. However, with the advent of high-precision weapons, many of the world’s forces can no longer maneuver freely on open terrain and have been forced to move to difficult terrain to negate the effectiveness of high-precision weaponry and to regain movement. Forests, jungle, mountains, swamp, and cities have long been the terrain of choice for less-technologically equipped forces to maximize their situational awareness and combat capabilities. The U.S. Armed Forces may have to fight guerrillas, paramilitary forces, or conventional forces in cities. Military medical support will share the burden of this tough fight. Casualties may be high. Last summer, a specially trained 980-man Marine Corps force “fought” a 160-man opposing force during an urban exercise in California. The Marines eventually took the housing area at a loss of some 100 casualties.¹ Compared to earlier urban exercises, Marine casualties were light, but the exercise was not a protracted conflict – which urban combat is likely to be.

Is there a unique role that military medicine will play in support of urban combat? The physician will still remove bullets and shrapnel or treat burns and disease. However, medical support to the combatants will pose some special tactical problems, particularly with finding the wounded, evacuating the patient, types of injuries encountered, preventive medicine, medical intelligence, and protection of medical facilities and patients.

Finding the Wounded

Many cities of the world are not laid out neatly in uniform rectangular blocks. Their streets twist and turn and they are easy to get lost in. Fighting further complicates “staying found.” Units fragment during urban combat. A battalion may start its advance at one end of a block, clearing rooms and occupying buildings to prevent

the enemy from retaking them. By the end of the block, the battalion is spread out and its combat power dissipated. Even platoon leaders have trouble maintaining control as their squads move into buildings – out of sight and often out of radio and voice contact. Urban combat is truly a squad leader’s fight and even the squad gets split up. Inevitably, soldiers or marines are moving alone or in pairs. If the command has failed to establish frequent rally points and brief the plan in detail to everyone, it is easy to get turned around and lost. Eventually, a soldier or marine is missing and his comrades try to determine when and where they saw him last. Does the platoon stop and retrace its steps looking for him or does it continue on with the mission? If the platoon goes on, the platoon medic is in a quandary. Does he go back and look for the missing man or does he stay with the platoon?²

Clearly, well before the platoon moves into the city, every member needs to be trained to administer first aid to himself and to carry sufficient medical supplies to take care of himself. Soldiers and marines are trained primarily to give first aid to others, so the act of self-administered first aid can be daunting to someone who is bleeding badly and slipping into shock. Training helps, but self-administered first aid is still tough to do. Perhaps science can help in this area. The Defense Advanced Research Products Agency is considering the development of an electronically controlled medical bodysuit that could actively assist in keeping the wounded soldier alive. Conceivably, such a suit could provide pressure on dressings where needed, create a tourniquet for an injured limb, stiffen and tighten around a limb to provide a temporary splint, treat the wearer for shock, monitor life signs and administer sedatives, nutrients, and painkillers. Development and fielding such a suit will take time. Something that is needed now that can be fielded more quickly is a tourniquet that can be put on with one hand.³ Another promising technology is a bandage coated with clotting agents to stop bleeding more effectively. The so-called fibrin bandages should be available relatively soon

once Food and Drug Administration approval is granted. Tourniquets and fibrin bandages are important since extremity injuries are common in urban combat and the possibility of bleeding to death is elevated.⁴

Buddy aid will still be the cornerstone of care in the urban arena. However, the extent and complexity of buddy aid training needs to increase substantially. The ability to preserve life until more sophisticated care can be delivered will require soldiers to become proficient in the basic “ABC’s” of first aid – airway control, breathing support, and circulation support.

Should the wounded soldier administer first aid to himself, how do the medic and the platoon find their missing member?⁵ Finding an unconscious soldier in a city can be difficult, particularly if there has been a fight producing rubble, falling walls, and blocked entrances. Fighting can also change the terrain a unit has passed over, making it hard to find familiar landmarks and to recognize sites. Personal Global Positioning System transponders are one possible answer, but cities are notorious for electronic dead space. Further, the enemy can read the electronic map of personnel locations as readily as the friendly force; this would provide a great source of intelligence to the enemy. If the transponder is only activated when the soldier is wounded, the wounded soldier has to be able to turn it on before losing consciousness. And, of course, the enemy would love to get a transponder from a dead soldier to use in baiting an ambush. Whistles and infrared strobe lights have the same drawbacks.

Evacuation

Once the wounded soldier is located, the next problem is evacuation. How does a platoon move an injured comrade from the 12th floor of a rubble-strewn building or from out of a collapsed storm sewer to a patient collecting point? Sledgehammers, axes, crowbars, ropes, harnesses, pulleys, jacks, pry bars, ladders, and carbide-tipped chain saws may be necessary to extract the wounded. Who maintains and carries this equipment? Who is trained to use it? How does the medic ensure that the wounded soldier survives the initial evacuation efforts? Most likely the medic is on foot. Does he lug a stretcher along or rely on an improvised poncho litter? Who carries the stretcher? The platoon has a full-time fight on its hands and the litter team should probably include a security element. Six people are usually essential for carrying a

litter over a long distance. Pulling a litter team and security element out of a platoon seriously degrades its combat strength. Therefore, prior to the action, the battalion medical element should be augmented with litter and security teams. Who provides this augmentation and who trains the augmentees?

Medical evacuation helicopters may be unable to fly into the city. During the 1994-1995 Battle for Grozny, the Chechens shot down several Russian medical evacuation helicopters, forcing the Russians to resort to ground evacuation within the confines of the city. Ground evacuation from the patient collection points was by field ambulance. The Chechens also shot up numerous soft-sided ambulances, forcing the Russians to use BTR-80 wheeled armored personnel carriers to evacuate the wounded.⁶ The BTR-80 is a poor ambulance. Entry is by small side doors and there is no way to carry a litter patient. What the Russians clearly needed was an armored ambulance. The venerable U.S. Army M113 personnel carrier makes a better ambulance, but its tracks tear up communications wire laid on the ground – the primary way of effectively communicating in a city. Analysis of U.S. fighting in Mogadishu suggests that the armored ambulance must offer protection from small-arms fire, be hardened against rocket-propelled grenade fire, be able to move through or over roadblocks, and be armed to protect patients and medical personnel.⁷

Urban combat forces a step back in time when dealing with medical evacuation. Litter evacuation will be common. Air evacuation will wait until the patient is moved to a safe location, possibly out of the city. Communication will be difficult due to the incompatibility of tactical radios and high-rise buildings. Urban combat lengthens the time between injury and surgical treatment. Most of the U.S. casualties in Mogadishu took up to 15 hours to evacuate to surgical treatment.⁸ The perennial problem of stabilizing the patient is compounded by the fact that evacuation now takes longer and the patient needs to be kept stabilized longer. Shock and loss of blood will significantly complicate the treatment of wounded waiting evacuation. Further, the delay to surgery will increase the amount of subsequent infections and increase the need for the early administration of antibiotics.⁹ Research is currently underway to evaluate the efficacy of the early administration of oral antibiotics in the field. It is likely that in the near future, a wounded soldier will take or be given

an oral antibiotic such as ciprofloxacin shortly after being injured.

Evacuation of casualties will be a challenge and given the complexities of urban combat, it may well be an insurmountable hurdle. Nevertheless, the primary objective remains to decrease mortality from battlefield injuries, not necessarily evacuating the injured. If sophisticated care could be quickly delivered near the scene of the injury, the need for early evacuation and all of the accompanying problems may be significantly reduced. This could be accomplished by increasing the level of care provided at squad and platoon level, improving basic care (bleeding and breathing) with advanced technologies, and finally providing advanced care far forward utilizing a very small footprint. Once the patient and the battlefield are stabilized, evacuation in a more controlled fashion could be attempted.

Type of Injuries

Urban combat produces a higher percentage of burns and shrapnel wounds as well as crushing injuries from falling walls. Many patients will be dehydrated. Psychiatric casualties may be much higher than normal. With the advent of effective body armor, wounds to the torso have fallen off while wounds to the unprotected portion of the head and to the extremities have increased. Russian casualties during the first Chechen War of the last century (Dec 94 - Oct 96) may be instructional. Although the Russian figures are not split between urban and mountain combat, a great deal of the war was fought in the cities of Grozny, Shali, Gudermes, Vedeno, Urus-Martan, and Argun. Furthermore, 28.6% of the almost 14,000 Russian wounded and injured in the war occurred in the initial fighting in Grozny from 31 Dec 94 to 20 Jan 95.¹⁰ Therefore, these figures can be used as a start point.

The physicians had to treat wounds, trauma, burns, and cold-weather injuries. Table 1 shows the percentage of each treated and the loss rate among those treated.

Wounded patients were the majority among the injured. Table 2 clearly demonstrates the efficacy of body armor in protecting the torso.

Of the above wounds, 17% were multiple wounds and 12% were compound wounds. The Russians note that

the main difference between their Afghanistan War statistics and these is that there was a higher incidence of bullet wounds to the head and neck during the urban combat phase of the war.¹³ However, mortars remain a major, if not the chief, casualty producer during urban combat.

Type of Injury	Number	Percent of total	Died despite treatment	Percent
Wounds	8319	60.5	117	1.4
Blunt Trauma	4665	34.0	32	0.7
Burns	542	3.9	15	2.8
Cold Weather Injury	213	1.6	1	0.5
Total	13739	100	165	1.2

Table 1. Medically Treated Injuries During the First Chechen War and Loss Rate¹¹

Wound Location	Percent of total	Light wounds	Medium wounds	Severe wounds
Head	19.8	32.9	28.3	38.8
Neck	1.7	37.9	32.5	29.6
Spine	1.2	9.7	19.9	70.4
Chest	6.6	29.0	34.0	37.0
Abdomen	3.2	34.7	31.5	33.8
Arms	22.9	48.3	15.2	36.5
Legs	39.9	47.5	24.5	28.0
Total	100.00	42.0	26.9	31.1

Table 2. Location of Wounds and Percentages of Each Among Russian Military Wounded in Chechnya 1994-1996¹²

The Russians experienced delays and difficulties in treating and evacuating the wounded. Among the wounded that required surgical care, 64.1% received first aid within 35 minutes of being wounded while 18.2 % of the wounded received first responder (medic) treatment within 55 minutes of being wounded. A doctor saw 56.2% of the wounded within two and one half hours.¹⁴ Table 3 shows the percentage of doctor-initiated first aid procedures that were required and actually performed among 1,030 wounded.

Medical Procedure	Percentage requiring Physician First Aid Procedure	Percentage receiving Physician First Aid Procedure
Eliminate asphyxia	1.7	0.8
Stop external bleeding	15.9	15.9
Use of a tourniquet	3.5	3.5
Administer IV fluids	50.6	25.3
Remove air from pleural cavity in a tension pneumothorax	1.0	0.5
Seal an open pneumothorax with an occlusive dressing	5.4	4.3
Administer novocaine blocks	36.7	15.9
Administer analgesics	100.0	80.3
Immobilize the patient for transport	49.7	33.2
Amputate an extremity which is hanging by a flap of skin	0.9	0.9
Restore urination	3.0	3.0
Administer antibiotics	88.9	72.3
Administer tetanic antitoxin	100.0	78.1
Administer oxygen	5.3	0.3

Table 3. Physician First Aid Required and Given to Wounded¹⁵

Russian field hospital surgical care to the wounded was divided into emergency surgery, urgent surgery, and deferred surgery. On average, emergency surgery was performed within an hour and 24 minutes of the patient's arrival at the hospital and 73.8% of the cases involved abdominal and chest wounds.¹⁶ Table 4 shows the types of emergency surgery as a percentage of all emergency surgery and the average time required to perform the surgery.

On average, urgent surgery was performed within 1 hour and 48 minutes of the arrival of the patient in the field hospital. The most common procedures were trepanation

to treat cerebral compression (20.8%), thoracentesis for a hemothorax (42.5%), and laparotomy while treating damaged hollow organs (17%).¹⁸ Table 5 shows the types of Russian urgent surgery as a percentage of all urgent surgery and the average time required to perform the surgery.

Type of operation	Percentage of total	Surgical time
Tracheotomy to treat asphyxia	0.7	30 minutes
Trepanation of the skull in the presence of external bleeding	2.1	138 ± 24 minutes
Stop external hemorrhage by ligature	1.4	96 ± 36 minutes
Stop external hemorrhage without suturing vessels	3.8	78 ± 12 minutes
Stop external bleeding by suturing vessels	3.1	144 ± 24 minutes
Stop external bleeding by temporary prosthetization of a blood vessel	1.8	114 ± 24 minutes
Enucleation of the eyeball when there is uncontrolled bleeding	0.3	48 minutes
Thoracotomy due to a cardiac tamponade	0.3	90 minutes
Thoracotomy due to uncontrolled pleural bleeding	3.4	204 ± 42 minutes
Thoracentesis for a tension pneumothorax	6.6	30 ± 6 minutes
Suturing a chest wound during an open pneumothorax	9.3	48 ± 6 minutes
Laparotomy while stopping an internal abdominal hemorrhage	54.1	270 ± 114 minutes
Amputation of severed or destroyed extremities	13.1	72 ± 18 minutes
Total	100	186 ± 66 minutes

Table 4. Types, Frequency, and Time Required for Emergency Surgery¹⁷

On average, deferred surgery was performed within 3 hours and 18 minutes of the arrival of the patient in the field hospital. The most common procedures were initial surgery for soft tissue wounds (41.3%) and surgery to repair gunshot wounds to the long tubular bones.²⁰ Table 6

Type of intervention	Percentage of total	Surgical time
Trepanation to treat cerebral compression	20.8	126 ± 6 minutes
Initial surgery and immobilizing broken jaw bone	0.9	60 minutes
Initial surgery for a penetrating wound to the nasal sinuses	0.9	60 minutes
Thoracentesis for a hemothorax	42.3	36 ± 6 minutes
Laparotomy while treating damaged hollow organs (intestines, bladder)	17.0	138 ± 6 minutes
Surgery for extraperitoneal injury to the rectum	3.3	132 ± 24 minutes
Surgery for extraperitoneal injury to the bladder	2.4	180 ± 18 minutes
Surgery for injury to the urethra	0.5	120 minutes
Final restoration of blood vessels during ischemia of the extremities	2.4	108 ± 18 minutes
Temporary prosthetization of blood vessels during ischemia of the extremities	2.4	120 ± 36 minutes
Amputation due to irreversible ischemia	3.8	150 ± 12 minutes
Initial surgical treatment of extensive and dirty wounds	3.3	108 ± 18 minutes
Total	100	84 ± 6 minutes

Table 5. Types, Frequency, and Time Required for Urgent Surgery¹⁹

shows the types of Russian deferred surgery as a percentage of all deferred surgery and the average time required to perform the surgery.

There is a new type of blunt trauma that has entered the urban arena. In the Second Chechen War, the Russians introduced the use of quantities of fuel-air or thermobaric weapons during the fight for Grozny from Dec 99 to Mar 00. Fuel-air weapons work by initially detonating a scattering charge within a warhead. The warhead contents

Type of Operation	Percentage of total	Surgical time
Initial surgical repair of skull and brain injuries	6.5	84 ± 12 minutes
Initial surgical repair of facial and jaw wounds	1.8	54 ± 12 minutes
Eye surgery	1.3	72 ± 18 minutes
Decompression lamination to treat spinal compression	0.3	210 minutes
Initial surgery for soft tissue wounds	41.4	72 ± 18 minutes
Initial surgery to repair bone injuries without fixation of fragments	41.4	72 ± 12 minutes
Initial surgery for bone injuries including fixation of fragments	7.3	74 ± 12 minutes
Total	100	54 ± 6 minutes

Table 6. Types, Frequency, and Time Required for Deferred Surgery

(volatile gases, liquids, or finely powdered explosives) form an aerosol cloud. This cloud is then ignited and the subsequent fireball sears the surrounding area while consuming the oxygen. The lack of oxygen creates a vacuum and subsequent enormous overpressure that is the primary casualty-producing force. Within several dozen microseconds, the pressure at the center of the explosion can reach 427 pounds per square inch (normal atmospheric pressure at sea level is 14.7 pounds per square inch). This is 1.5 to 2 times greater than the overpressure caused by conventional explosives. Personnel under the cloud are crushed to death.²²

There is little written about the results of the Russian fuel-air weapons used against the Chechens. However, the results are intuitive. Personnel caught under the blast die immediately from flame and overpressure. Personnel on the periphery of the blast are subject to burns, broken bones, contusions from flying debris, and blindness. Air embolism within blood vessels, concussions, multiple internal hemorrhages in the liver and spleen, collapsed lungs, ruptured eardrums and eyes displaced from their sockets are also likely. Peritonitis can result from displacement and tearing of the internal organs. While military medics are well trained in treating casualties with

external injuries (stop the bleeding, protect the wound, treat for shock), the internal injuries caused by fuel-air weapons may go unnoticed. Corpsmen should train to look for evidence of blast injuries such as the presence of fluid or blood behind the eardrums as a possible indicator of pulmonary complications.²³ Air evacuation of fuel-air casualties will be problematic without cabin pressurization.

Weapons of mass effect (chemical, biological, and even nuclear) may be used in cities with devastating effect. Combatants and civilians are massed in a limited area where the weapon's effects can be devastating. Medical personnel may have to perform mass casualty treatment while wearing chemical suits and protective masks.

Preventive Medicine

Disease was a major problem for the Russians engaged in urban combat in Chechnya. The difficulty in maintaining proper field sanitation in urban combat meant that 95% of infectious disease among Russian combatants was passed through oral-fecal transmission. Over half of the intestinally-related infections (53.2%) were from viral hepatitis, while 27.7% were from shigellosis and 20.1% were from enterocolitis. Diphtheria, cholera, malignant anthrax, and plague also found victims among the Russian soldiers. Dirty water was the main culprit in the transmission of hepatitis. Medical records of one Russian brigade show that 15% of the brigade was down with hepatitis at one time.²⁴

The Russian Army is not the only Army with a disease problem. In Vietnam, over two-thirds of U.S. Army hospital admissions were for disease. In 1968, disease cost U.S. forces some 943,809 man-days – roughly the equivalent of an infantry division for 2 months.²⁵ Urban combat will provide unique challenges for epidemiologic control. Unburied bodies, broken sewers, polluted water supplies, local foodstuffs, exotic beverages, rats, insects, and feral animals all represent threats to the health of the force. Increased efforts in vaccine development will be important to limit the threat of these diseases. However, efforts and policies to vaccinate the local populace will also be important. Although there may be a significant financial cost to vaccinate a large city against illnesses such as hepatitis, the long-term savings may offset the initial expense.

Medical Intelligence

Urban medical intelligence starts well before the force enters the city. A good epidemiologic profile will prompt precautions and preventive measures. A good medical survey will pinpoint existing hospitals, clinics, sanitariums, blood banks, pharmaceutical industries, medical supply warehouses, veterinary facilities, and public health facilities and identify key indigenous medical personnel. The survey will also identify potential areas of health risk such as chemical plants, refineries, smelters, and waste disposal areas. Modern mapping programs will allow medical intelligence personnel to post survey data and other pertinent data – such as the location of contagious disease outbreaks, high-speed routes to medical facilities, underground locations suitable for setting up a field hospital – on electronic and printed maps.

Intelligence on the enemy medical status is also valuable. Not only does it disclose enemy strengths and weaknesses, but it can also alert friendly medical units as to what diseases and conditions enemy prisoners of war might require treatment for. Part of medical intelligence can be determined before entry into the city, but most of it will be developed once the force is committed. Medical personnel are a prime source of intelligence provided that they are trained on how to observe and report pertinent data. Types and frequency of wounds and disease, attitudes of enemy prisoners undergoing treatment, type and utility of captured enemy medical supplies and observations of the local populace are all important sources of intelligence that medical personnel should provide.²⁶

Medical intelligence will also be invaluable to detect the use of chemical or biological weapons. These agents may be more difficult to detect in urban areas specifically because of the closeness of the population, the sanitary problems associated with cities, and the general breakdown of support services and infrastructure.

Protection of Medical Facilities and Patients

Medical facilities must be protected. Frequently, their best location is outside the city near major roads and an airfield or port. However, medical facilities will often be located inside the contested city as well. Obviously, the best place to establish a medical facility is often inside an

established hospital or clinic. However, civilian medical facilities are often overcrowded in peacetime. Fighting will make them more so. Space and security concerns will usually dictate that military and civilian medical facilities are in separate locations. Use of foreign health care facilities may be complicated by sub-standard facilities when compared to accepted standards of care. Also, medical systems may not be compatible. These types of problems are common at U.S. cities that have well developed hospital systems, so one can imagine how difficult this would be in a foreign city.

A thinking enemy will identify urban sites that U.S. forces are likely to use for headquarters, facilities, and hospitals. They will target these and may booby trap or mine them. Sites should be carefully checked and protected. Protection of patients is a primary military concern, so sturdy buildings with clean basements are often prime locations. However, if chemical weapons are used, many chemical agents tend to hug low places. The medical facility should be secure from ground attack as well as mortar and artillery attack. The top floors of most buildings are vulnerable to artillery and mortar fire, so the medical facilities should occupy the lower floors and basement. Enemy prisoners of war will often be treated in the same facility as friendly troops, so establishment of secure prison wards will be an immediate concern.

Protection of patients goes beyond the medical facility. Patient protection extends from the initial litter evacuation to flying a patient to a permanent medical facility. Litter protection parties, armored ambulances, well-patrolled evacuation routes, and secure helipads all contribute.

Street Smarts

Armies avoid cities for a good reason. Cities are difficult to fight in and take an inordinate number of troops. However, the reluctance of an Army to fight in a city is an incentive for an enemy to use it as a refuge. Sometimes urban combat cannot be avoided. Urban combat places extra demands on military medicine. Military medical personnel may find themselves fully involved in supporting the civilian community as well their own military and enemy prisoners of war.

A separate issue is providing medical care within a

coalition. The U.S. force may be fighting alongside allies and have to provide medical care for allied personnel. Differences in culture, diet, and accepted medical procedures may present difficulties to U.S. medical personnel. In order to minimize the difficulties they are likely to encounter in coalition warfare, coalition staffs should have medical officers who can work and plan together to minimize these problems. Medical command and control will not happen without prior planning and training. Often, medical personnel may have to conduct medical work-ups and diagnoses or coordinate large-scale medical support using an interpreter who has a limited medical vocabulary in either language. Again, with prior planning and training, the impact of these language and cultural barriers can be minimized, if not removed all together.

The nature of the large city will have a decided impact on the missions of military medicine. Much of the urban population cannot abandon the city. There simply is no place for all of them to go. Where would the populace of New York or Los Angeles go? There are even fewer options when dealing with the evacuation of the civilian populace of Mexico City, Lagos, Cairo, or Rawalpindi. Most civilians will stay in place, try to protect their property, and try to avoid the fighting. Defenders often will not let civilians leave, since they restrict the capability of the attacker. Civilians won't be able to stay out of harm's way. Some will become combatants. The bulk of casualties in city fighting are usually civilians. Sewage systems, power generating plants, water treatment plants and other utilities are vulnerable and, when knocked out, increase the risk of disease and epidemics. A breakdown in public safety, city services and public health can lead to looting, further disease, riots, unchecked conflagrations, and untreated casualties. Any fighting will interrupt normal commerce and severe interruptions can stop the delivery of medicine, food, and fuel. The populace will look to government and local authority to restore power, sewage, good order, public health, transport, and essential commerce. Often, government and local authority is represented solely by the military and the senior military commander will find that his responsibilities extend far beyond immediate combat. Military engineers, communicators, police, transporters, lawyers, civil affairs, and medical personnel may find themselves doing nontraditional, yet vital tasks to support the senior commander in the struggle for the city.

On the operational side, military medical personnel may find themselves reestablishing city public health systems, operating clinics for civilians, training public health workers, conducting or supervising epidemiologic teams, checking water and food, restocking local hospitals, working with nongovernment relief and charitable organizations, and other aid organizations while continuing their primary mission of supporting the military. Clearly, the medical effort will require additional resources to handle an expanded mission and provide aid to the civilian community. Triage efforts may deal with civilians and military simultaneously.

Urban combat is difficult – and so is medical support to that combat. However, with training, preparation and foresight, both can be managed.

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